

# A Reusable, Oxidizer-Cooled, Hybrid Aerospike Rocket Motor for Flight Test, Phase I

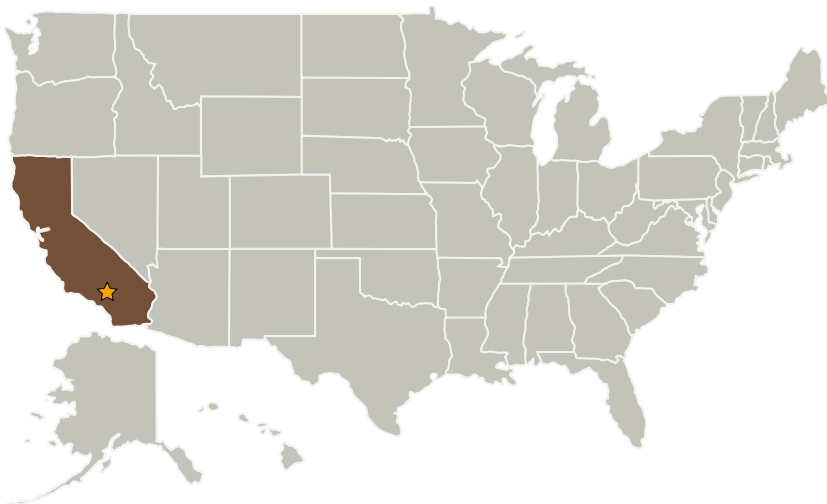
Completed Technology Project (2008 - 2009)



## Project Introduction

The proposed innovation is to use the refrigerant capabilities of nitrous oxide (N<sub>2</sub>O) to provide the cooling required for reusable operation of an aerospike nozzle in conjunction with an N<sub>2</sub>O-HTPB hybrid rocket motor. The phase change cooling as liquid N<sub>2</sub>O is flashed into a vapor is crucial to limiting to acceptable levels the erosion of both the nozzle throat and spike, thereby enabling reusable operation and/or long burn times. The N<sub>2</sub>O used for cooling the nozzle throat will be reintroduced into the combustion chamber, and the N<sub>2</sub>O used for cooling the spike will be used to provide base bleed, virtually eliminating any performance penalty associated with using a severely truncated, and therefore significantly lighter, spike. Because of its high vapor pressure, N<sub>2</sub>O can be self-pumping, thereby making it an ideal choice of oxidizer for simple, low-cost applications. As a simple, practical nozzle, the proposed innovation fits well with N<sub>2</sub>O-HTPB hybrid rocket designs, which tend toward simpler, less expensive design alternatives. Because of their high efficiency due to altitude compensation, aerospike nozzles could play an important role in bringing to fruition inexpensive access to low Earth orbit. In addition, these altitude compensating nozzles could provide significantly increased performance for a wide array of tactical missiles. Although a few rocket flights powered by liquid propellant rocket engines and two flights powered by solid propellant rocket motors have used aerospike nozzles in the last several years, the lack of a comprehensive flight test database has precluded the use of these nozzles in current as well as next-generation space vehicles. The simple, low-cost, reusable, oxidizer-cooled aerospike nozzle for operation on an N<sub>2</sub>O-HTPB hybrid rocket motor that is proposed herein is a device that will enable much-needed flight research of aerospike nozzles.

## Primary U.S. Work Locations and Key Partners



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## Organizational Responsibility

### Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

### Lead Center / Facility:

Armstrong Flight Research Center (AFRC)

### Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

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Organizations Performing Work	Role	Type	Location
★Armstrong Flight Research Center(AFRC)	Lead Organization	NASA Center	Edwards, California
Rolling Hills Research Corporation	Supporting Organization	Industry	El Segundo, California

## Primary U.S. Work Locations

California

## Project Management

### Program Director:

Jason L Kessler

### Program Manager:

Carlos Torrez

## Technology Areas

### Primary:

- TX01 Propulsion Systems
  - └ TX01.1 Chemical Space Propulsion
  - └ TX01.1.5 Hybrids